EPA Administrator
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460
**Submitted via e-mailed to: a-and-r-docket@epa.gov**

October 9th, 2007

Re: **Proposed National Ambient Air Quality Standards for Ozone**
**Docket ID No. EPA-HQ-OAR-2005-0172**

The undersigned groups submit these comments to the EPA Administrator and staff regarding the proposed revisions to the national ambient air quality standard (NAAQS) for ozone (Docket ID No. EPA-HQ-OAR-2005-0172). We represent conservation and recreation organizations from across the United States with a collective membership of over 1.5 million nationally. Given our organizations focus on protecting national parks, Wilderness areas, and the natural environment our comments concentrate on the secondary standard. However, the proposed changes to the primary standard are also an important point of concern.

Our members spend the summer months hiking and recreating in the mountains and natural areas of the United States. It is documented that high concentrations of ozone are often found at higher elevations. The Appalachian Mountain Club's research has definitively linked hiker lung function impairment in the White Mountains of New Hampshire to 8-hour ozone pollution exposure. Brigham and Women's Hospital, Harvard School of Public Health, and the Appalachian Mountain Club (AMC) conducted a three-year study to examine health effects of rural air pollution on hikers on Mount Washington. The study, *Effects of Ozone and Other Pollutants on the Pulmonary Function of Adult Hikers* published in Environmental Health Perspectives 1998, demonstrated that ozone, and to a lesser extent fine particulate matter, result in acute respiratory impacts to healthy, active adults hiking at higher elevation in Eastern mountains. These impacts occurred at levels below the 1997 NAAQS for ozone. In addition, it was found that the number of hours hiked was an independent predictor of declines in measures of pulmonary function, i.e. longer hikes = greater doses. The paper concludes: "Physicians, public health officials and the general public should be aware of the potential acute impacts of relatively low-level pollutants not only among residents of urban and industrial regions but also among individuals engages in outdoor recreation in certain wilderness areas."

**Recommendation: The Primary Standard**
We support the *most protective* recommendations of the Clean Air Science Advisory Committee (CASAC) and the position taken by the American Lung Association regarding the primary standard and strongly urge the EPA to adopt a primary standard that will truly protect public health. The recommendations we support are:

- 8-hour average primary standard should be set to 0.060 ppm to protect public health with a margin of safety as required by the Clean Air Act. – **Hikers, outdoor recreationists and others exercising outdoors will inhale considerably more ozone due to greater outdoor physical activity so the more protective level is essential to protect our members.**

- EPA should eliminate the rounding loophole that lets cities who 'just fail' the standard to escape from cleaning up their ozone. - **Mountains are often at the mercy of accumulated pollution from upwind urban corridors and it is**

**important that each source city do their part to improve local and regional air quality.**

**Recommendation: The Secondary Standard**
We would like to submit the following points (the rational of which is discussed in detail in the subsequent text) regarding the proposed changes to the secondary ozone standard:

- The secondary standard should use an *annual* cumulative weighted index, not an averaging over *multiple years* that would result in high ozone years being averaged out. **One high ozone year can contribute to the cumulative impacts of ozone to vegetation**.

- We strongly urge the EPA to use a *24-hour*, *5-month* summation period for the cumulative index (W126 metric) not the *12-hour* and the *3 highest continuous month* summation periods. **There is significant evidence that plants are affected by ozone pollution at night and that both 24 hour and seasonal impacts are cumulative.**

- We urge the more protective 7 ppm-hours level, proposed by the EPA, be adopted for areas with known sensitive species and areas under special federal protection related to air quality. **This protective approach should be used to ensure that Federal Land Managers are able, as directed by Congress, to protect the air quality-related values in our National Parks and Forests and Wilderness areas for future generations.**

- The upper end of the proposed range by EPA, 21-ppm-hours, is not protective enough. **This level was rejected in the 1997 review as not being protective enough and a recent key scientific study has shown, using a 24-hour summation window, that plant and ecosystem damage can occur at this level.**

- The standard should be based on the full growing season of a region and this should be re-evaluated over time. **Growing seasons are expanding due to climate change.**

- The secondary standard, to be truly protective for vegetation, should **not replicate the implementation methods established for the primary standard**, which is based on human population centers.

- Federally protected and large contiguous natural areas with known sensitive species should receive **additional funding for ozone monitoring with a focus on higher elevations.**

**Ozone in National Parks and Natural Areas**
National Parks and other outdoor destinations that are highly valued for the flora and fauna they harbor should be well protected by a secondary NAAQS. The Clean Air Act, as amended in 1977, calls for the nation to "…preserve, protect and enhance the air quality in national parks,…and other areas of special national or regional natural, recreational, scenic, or historic value.". Furthermore, a Senate Report from 1977 states "…the Federal Land Manager (FLM) should assume an active role in protecting the air quality related values of land areas under their jurisdiction. In cases of doubt the land manager should err on the side of protecting the air quality-related values for future generations." *(Senate Report No. 95-127, 95th Congress, 1977)*

Based on the direction of Congress in 1977, special consideration should be given when setting the secondary ozone standards to the impacts in National Parks and natural areas. National Parks serve as a classroom for understanding the effects of ozone on plant life. In the Great Smoky Mountains, Mammoth Caves, Shenandoah, Acadia, and Sequoia-Kings Canyon, and countless other National Parks the effects of ozone pollution are continually becoming better understood. A variety of new data is now available that the EPA must take into consideration when considering the parameters of the secondary standard. For instance, it is now well accepted that due to direct transport, little mixing and little NOx scavenging that ozone concentrations can be higher at higher elevations seriously affecting plant health (and human health as highlighted in the AMC hiker study in New Hampshire).

It is well accepted that many trees and other plants suffer damage from ozone at even lower levels than those established to protect humans. Ozone can damage and kill leaves, affecting a plants ability to produce food. In turn, this can reduce plant growth and resistance to diseases and pests, potentially leading to long term effects on forests and ecosystems (NPS, Air Resource Division, "Air Quality in Our National Parks, second edition" September 2002: p. 21-23). A broad range of plants, from sequoia seedlings and ponderosa pines to tulip trees and blackberries are sensitive to ozone pollution (NPS Air Resources Division and U.S. Fish and Wildlife Services Air Quality Branch, "Ozone Sensitive Plant Species on National Park Service and U.S. Fish and Wildlife Service Lands: Results of June 24-25, 2003 Workshop," November 2003).

Ozone trends in National Parks (see Table 1) indicate an increase or no improvement in ozone pollution in National Parks across the nation. While other parks and regions have improved there is still a trend that threatens plant life and park visitors.

**Table 1. Ozone trend from 1995-2004 (average 3-year 4th Highest 8-Hour)**

| **National Park** | **Ozone Trend**[1] (ppb/year) |
|---|---|
| Acadia | 1.37 ⬆ |
| Shenandoah | No change |
| Great Smoky Mountain | No change |
| Everglades | No change |
| Rocky Mountain | 1.00 ⬆ |
| Glacier | 0.60 ⬆ |
| Mesa Verde | 0.67 ⬆ |
| Sequoia | 0.50 ⬆ |
| Yellowstone | 0.83 ⬆ |
| Yosemite | No change |

*Source: NPS, GRPA 2005*

Negative trends indicate pollution is decreasing, ⬇, (improvement) while positive trends indicate pollution is increasing, ⬆, (degradation of air quality). Numbers that show a trend sign have statistical significance with a p less than or equal to 0.05.

**Secondary Standard should be a 24-hour metric**

We appreciate that the Staff paper reviewed the current literature related to nocturnal ozone uptake in consideration of a 24-hour secondary standard. However, we strongly disagree

[1] Ozone trend is calculated from annual May-September.

with the Staff and Administrators opinion that more evidence is needed “about the extent to which this co-occurrence of sensitive species and elevated nocturnal O3 exposure exists” (Fed. Reg. Vol. 72 No. 132 p.37901) to warrant a 24-hour standard. We provide below some key examples of National Parks and other federal lands with both elevated nighttime ozone exposure and presence of sensitive species. Further we discuss the important recent studies by McLaughlin et al (2007 a and b) that supports others finding that ozone exposure reduces stomatal control and amplifies water loss and ozone exposure at nighttime as well as during the day. Night-time stomatal conductance and transpiration has been observed in a broad range of plants (Musselman and Minnick 2000, Snyder et al., 2003, Grulke et al., 2004, McLaughlin et al., 2007 a and b). Furthermore nighttime ozone exposure has been shown to cause reductions in plant biomass for some species (Matyssek et al., 1995, McLaughlin, et al., 2007a). These studies, taken together, elucidates that ecosystem wide impacts can occur from cumulative ozone exposure and most recently this has been shown in a study by McLaughlin, et al. (2007b).

Mountain tops often experience higher ozone levels than adjacent valleys and air masses reaching higher elevations are considered characteristic of the regional air quality. A recent analysis of air masses with enhanced ozone levels (>80 ppbv) reaching the summit of Mount Washington (6,288’) indicates that this polluted air is rapidly transported from the Mid-west and southwest while a nearby low elevation site does not experience the same patterns in regional air pollution events (Fischer, et al., 2004, AMC unpublished data). There is not always a direct correlation between higher ozone levels with increasing altitude as concentration are also largely related to the region’s meteorology and location of the upwind source pollution. However, there are many parks and protected lands that experience higher concentrations on mountain summits, often at night, and others such as Acadia National Park that see long-range transport and late evening peaks in ozone. Below we provide four examples, showing air pollution events with nighttime peak levels and our calculation of the sites W126 metric using the proposed summation period (12-hr and 3 contiguous months) and using 24-hour and 5 month intervals. We also discuss the known ozone sensitive species found at these sites.

*Acadia National Park- Maine*

Acadia National Park is a coastal Class I Area located on Mount Desert Island near Bar Harbor, Maine. It is currently in non-attainment of the 8-hour ozone standard. Acadia is unfortunately situated downwind of Eastern US ozone pollution source regions. Transport to this park occurs over the day and into the evening with peak ozone levels often occurring at 10 pm in the evening. Figure 1 shows an air pollution event at Acadia NP and highlights how the 12-hour daytime window proposed misses the higher ozone exposure levels that happen in the evening and throughout the night.

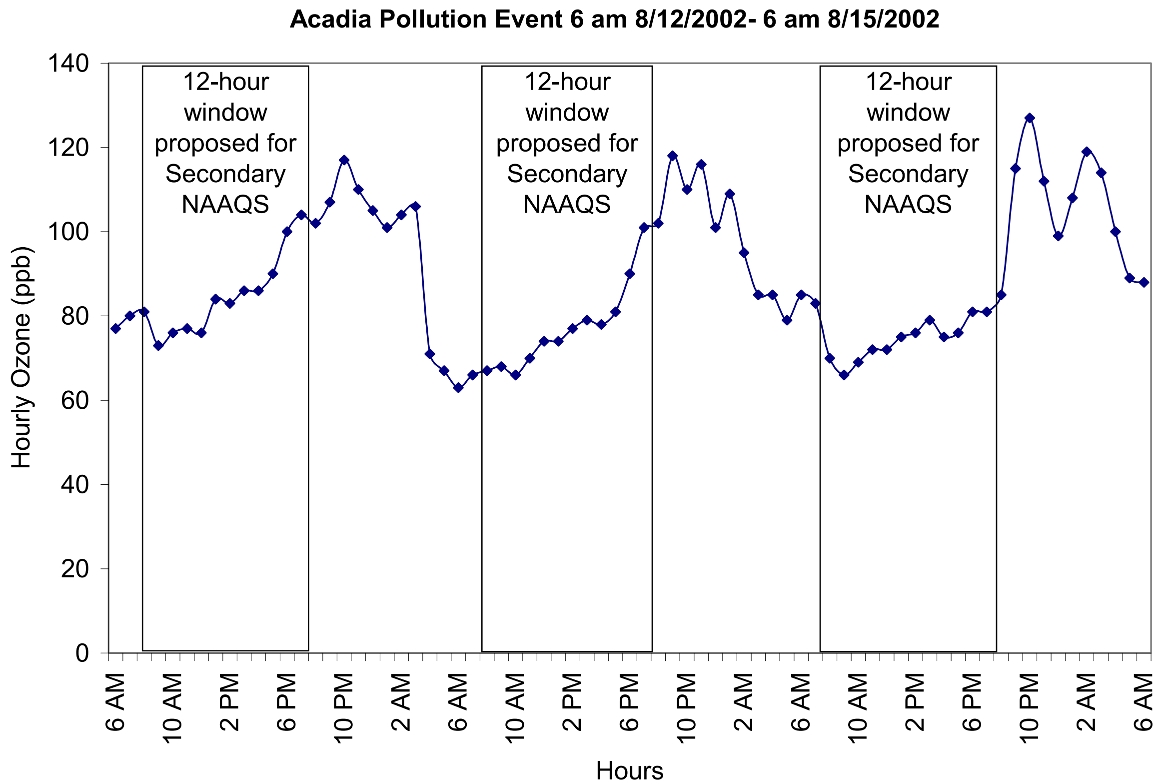


**Figure 1. Acadia National Park pollution event hourly ozone concentrations from Cadillac Mountain (466 m). Data source: NPS**

Table 2 shows the differences in the W126 values at Acadia NP under different summation windows for 2002 and 2003. This table highlights that if a 12-hour metric is used it will underestimate the cumulative exposures at Acadia as a result of frequent nighttime peaks. Furthermore, a 5-month summation window can result in a significantly higher W126 value as in 2002.

**Table 2. Ozone W126 (ppm-hrs) for Acadia NP Cadillac Mountain 466 m. Data source: NPS**

| **Metric** | **2002** | **2003** |
|---|---|---|
| W126 24-hr, 5 Months | 32.6 | 21.8 |
| W126 24-hr, 3 Months* | 21.7 | 18.8 |
| W126 12-hr, 3 Months* | 11.6 | 10.7 |

***3 months = 3 maximum contiguous summer months.**

At Acadia National Park *Populus tremuloides* and *Prunus serotina*, quaking aspen and black cherry, are two of the known ozone sensitive species identified by the National Park Service. In addition, these species have also been identified as showing nocturnal stomatal conductance in the review by Musselman and Minnick (2000).

*Great Gulf and Presidential Dry River Wilderness Areas- New Hampshire*

In NH the AMC assists in air quality monitoring in two Class I Wilderness Areas on Mount Washington in collaboration with the NH Department of Environmental Services. Long-term monitoring of ozone at the summit and base of the mountain has demonstrated

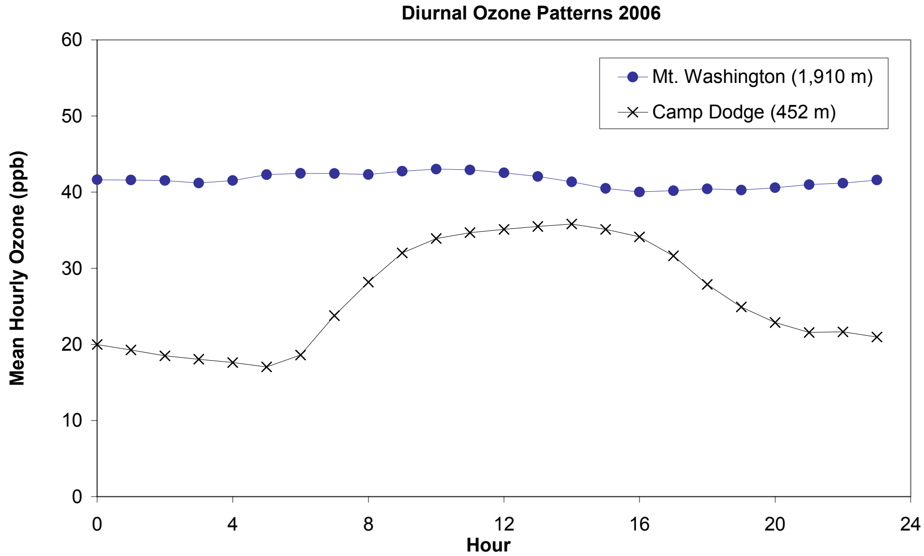


**Figure 2. Diurnal ozone pattern on Mount Washington summit (1910 m) and Camp Dodge base (452 m) using mean hourly values for the summer of 2006. Data source: AMC/NH DES**

that the higher elevation site sees little ozone scavenging and peaks often occur in the late evening/early morning. The average summer-time diurnal pattern is shown in Figure 2. During a pollution event the peak ozone exposure times at the high elevation site are opposite to the daytime maxima measured at the base of the mountain, see Figure 3. Table 3, summarizing 2002 and 2006 data, further shows if the 12-hour metric is used that it will underestimate the cumulative exposures at the summit site.

**Table 3. Ozone W126 metric calculations for the summit and base of Mount Washington, NH**

| | 2002 | | 2006 | |
|---|---|---|---|---|
| **Metric** | **Summit (1910 m)** | **Base (452 m)** | **Summit (1910 m)** | **Base (452 m)** |
| W126 (ppm-hrs), 24 hrs 5 months | 38.6 | 6.5 | 15.6 | 3.1 |
| W126 (ppm-hrs), 24 hrs 3 months* | 23.0 | 3.6 | 10.6 | 1.9 |
| W126 (ppm-hrs), 12 hrs 3 months* | 10.7 | 3.0 | 5.6 | 1.5 |

***3 months = 3 maximum contiguous summer months.**

In a report by Smith and Manning (1990) *Alnus sp*., *Betula sp*., *Sorbus Americana*, *Spiraea latifolia* were found to have ozone injury at sites that ranged elevation of 2600’ to 2900’ in 1988 and 1989 near the Class I Wilderness Areas in NH on Mount Washington. This study also reported on a survey in the Class I areas that ranged from 500-5,018 feet where the following plants also showed ozone injury symptoms: *Acer spictum, Aralia nudicaulis, Cornus spp., Ostry virginiana, Poa spp., Viburnum alnifolium*, and *Vaccinium spp*. Black cherry was also assessed at lower elevation permanent plots, 1600’ and lower, and showed severe to no ozone injury in the two sample years.

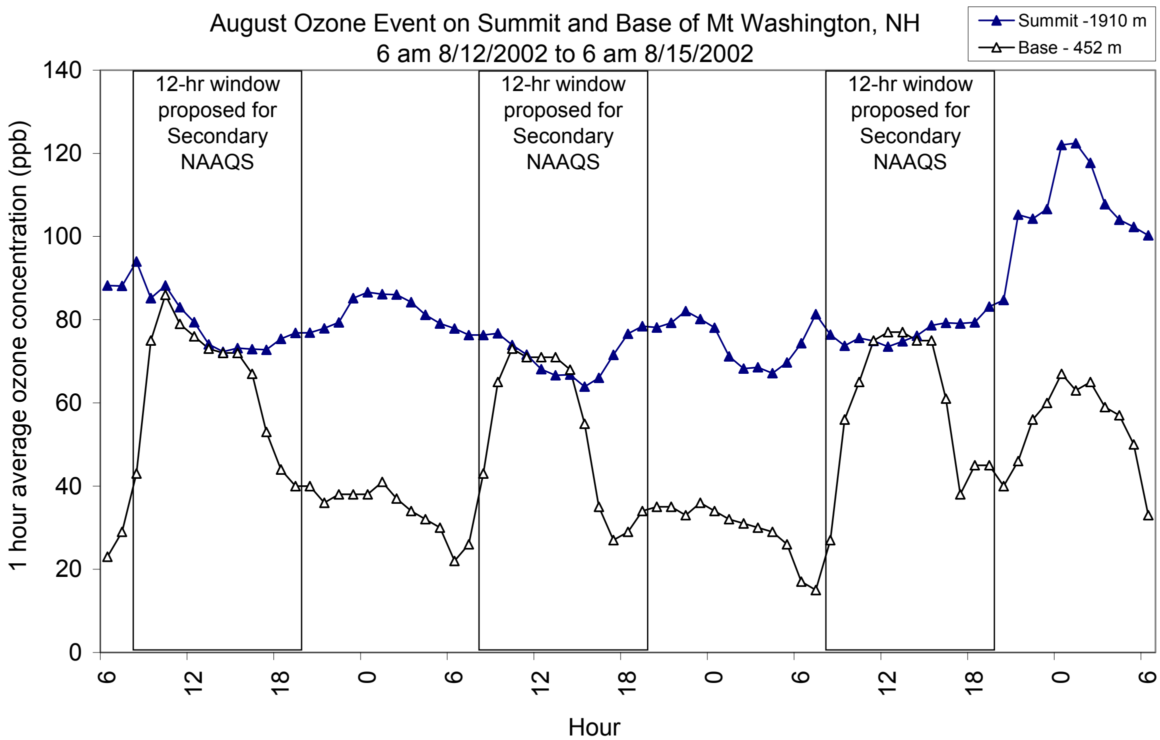


**Figure 3. Great Gulf Wilderness area pollution event hourly ozone concentrations from Mount Washington summit (1910 m) and Camp Dodge base (452 m). Data source: AMC/NH DES**

*<u>Great Smoky Mountains National Park- Tennessee</u>*

Significant work has been done in Great Smoky Mountain National Park (GSMNP) related to ozone regimes at different elevations and ozone impact to the vegetation. While some of this work was discussed throughout the staff paper, the most recent and highly significant studies (McLaughlin, et al., 2007 a and b) were published after the completion of the staff paper. We believe this work should be considered by the Administrator in the final decision making process. It was summarized by a CASAC committee member, Dr. Rich Poirot, and submitted to staff on March 19$^{th}$, 2007. While we will not repeat this summary we will refer to key points in the discussion below.

Figure 4 shows a pollution event in GSMNP where peak ozone occurs either early or late evening. This significant diurnal pattern at this location results in the W126 being more than 2 times as much if summed on a 24-hour basis instead of a 12-hour window for 2002 and 2003, Table 4.

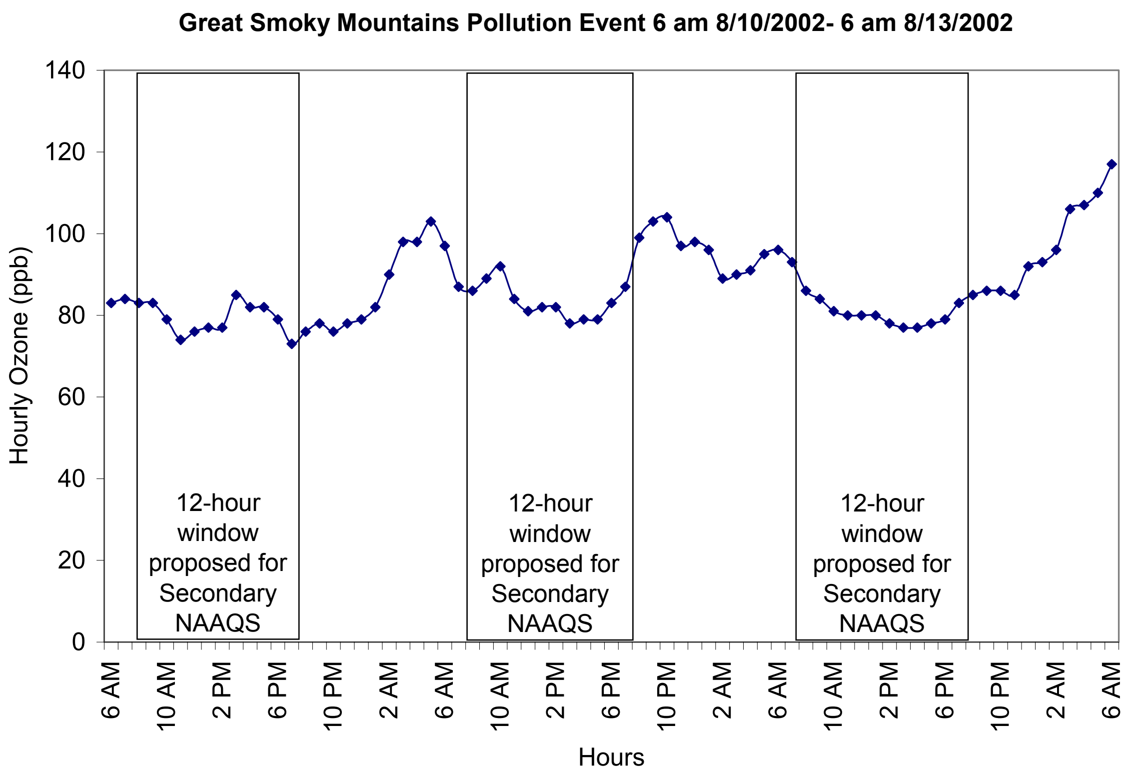


**Figure 4. Great Smoky Mountains National Park pollution event hourly ozone concentrations from Clingman's Dome (2,021 m). Data source: NPS**

The National Park Service has identified 24 ozone sensitive plant species for GSMNP, two of which *Liriodendron tulipifera* and *Prunus serotina*, yellow-poplar and black cherry, have also been identified as showing nocturnal stomatal conductance in the review by Musselman and Minnick (2000). Yellow-poplar is found up to 4,500' in the southern Appalachian mountains. This species was found to have significant reduced circumference growth in response to ozone exposure at 3 locations in GSMNP (McLaughlin, et al., 2007a). In the same study Pitch Pine and Red Oak were found to be the most sensitive, of the trees studied, to ozone episodic events that caused growth loss and stem shrinkage. Red Oak has been identified as having nocturnal stomatal conductance (Musselman and Minnick, 2000). As discussed by Poirot in his CASAC comments, McLaughlin et al. (2007 a and b) reported impacts from ozone at levels below the upper range proposed by EPA of 21 ppm-hours for 2001 and 2003 for the Look Rock site in GSMNP. Also of significance is that the study used 24-hour summation window and not a 12-hour as proposed.

**Table 4. Ozone W126 (ppm-hr) for Great Smoky Mountains – Clingman's Dome (2,021 m) Data Source: NPS**

| Metric | 2002 | 2003 |
|---|---|---|
| W126 24-hr, 5 Months | 95.5 | 54.1 |
| W126 24-hr, 3 Months* | 69.9 | 36.4 |
| W126 12-hr, 3 Months* | 30.3 | 15.2 |

***3 months = 3 maximum contiguous summer months.**

*Crestline in San Bernadino Mountains, California*

Research on Ponderosa pine in the San Bernadino Mountains of California has found that this species is sensitive to chronic ozone exposure and also experiences nocturnal uptake of ozone in early summer (Grulke,et al., 2004). Ponderosa pine can exist in mid and western high elevation mountain ranges while most established stands are found at 4000-8000 feet and at Crestline there is evidence of nighttime ozone pollution events, Figure 5. While secondary nighttime peaks are not as pronounced as those during the day at this site, in the June of 1999 pollution event the nighttime levels are significant; remaining above 80 ppb and peaking above 100 ppb.

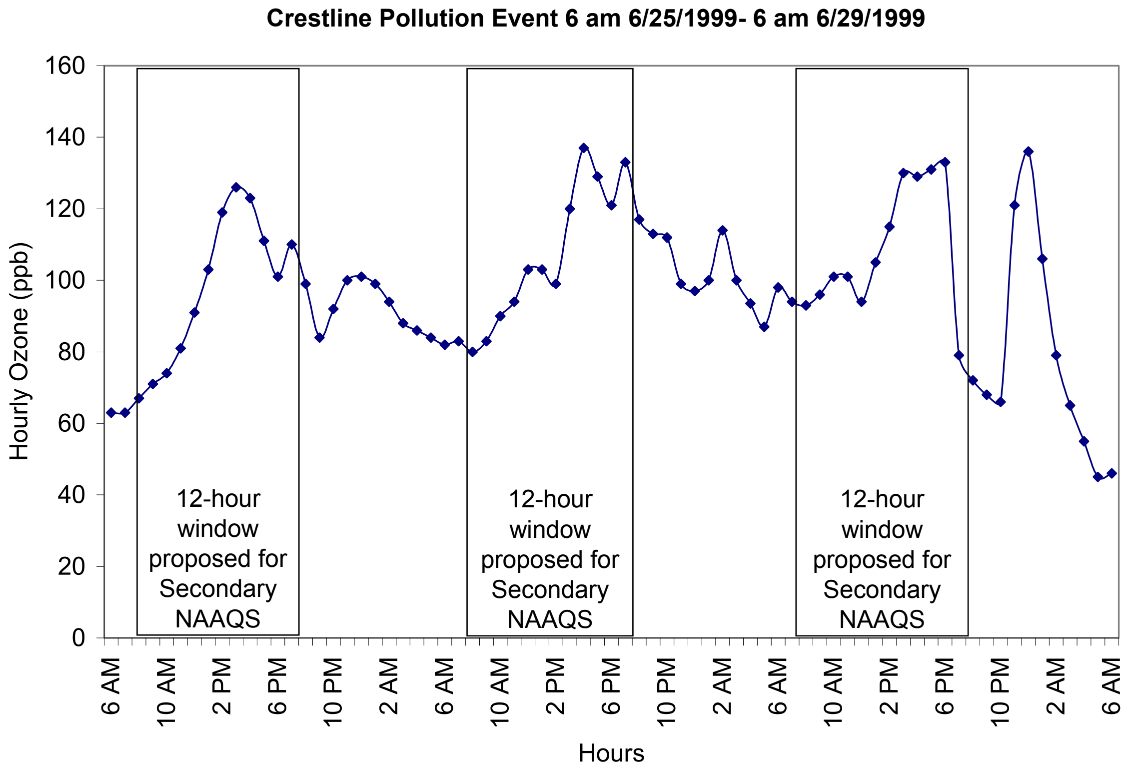


**Figure 5. San Bernadino Mountains, California pollution event hourly ozone concentrations from Crestline (1,384 m). Data source: NPS**

While all of the various metric summation windows are high at this site for the example years of 1999 and 2000, Table 5, the difference between them are substantial. The secondary NAAQS should reflect the *true cumulative exposure* to the plants that the standard is designed to protect.

**Table 5. Ozone W126 (ppm-hr) for Crestline   Data Source: USFS/CARB**

| Metric | 1999 | 2000 |
|---|---|---|
| W126 24-hr, 5 Months | 132.1 | 104.4 |
| W126 24-hr, 3 Months* | 94.3 | 76.8 |
| W126 12-hr, 3 Months* | 69.1 | 59.2 |

***3 months = 3 maximum contiguous summer months.**

**Secondary ozone standard should be cumulative from May – September**
The ozone season for the secondary standard should range from May to September to fully protect plant and ecosystem health. Figure 6, from Fisher et al., 2007, shows estimation of spring onset estimated from MODIS imagery. This estimation suggests that even at the higher latitudes the deciduous tree canopy is 50% developed by May 1st and bud break and partial canopy development is happening through April. Clearly photosynthesis in conifers and early emerging forest floor species would begin in April and even earlier in some regions. EPA should not limit the season to the highest 3 contiguous months as ozone impacts are cumulative throughout the whole biologically active season.

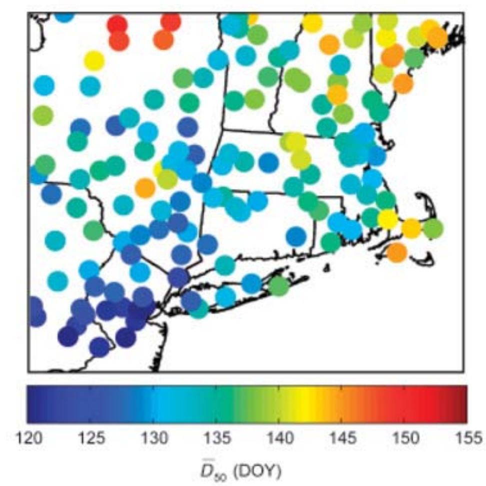


**Figure 6. Average date of spring onset (50% canopy development), estimated from MODIS imagery. From Fisher et al., 2007.**

**Monitoring to support the secondary Ozone NAAQS**

We appreciate that EPA is taking comment on monitoring issues. The monitoring to support the secondary NAAQS should include mandatory monitors, and where appropriate located at multiple elevations, in federally protected natural resources, such as Class I Wilderness areas, and ecosystems with known sensitive species. While many of these areas have ozone monitors as part of CASTNET or FLM funded monitoring it should be mandated as part of this rule making and these existing monitor networks should be supported.

In addition, implementation of attainment of the secondary standard should not replicate the implementation established for the primary standard as these are based on human population centers and not designed for vegetation protection.

Respectfully submitted,

Georgia Murray
Appalachian Mountain Club

Ben Rose
Green Mountain Club

Celina Montorfano
American Hiking Society

Ulla-Britt Reeves
Southern Alliance for Clean Energy

Bart Melton
National Parks Conservation Association

Walt Daniels
New York – New Jersey Trail Conference

Neil Woodworth
Adirondack Mountain Club

Alice McKeown
Sierra Club

## REFERENCES


N. E. Grulke, R. Alonso, T. Nguyen, C. Cascio and W. Dobrowolski (2004) Stomata open at night in pole-sized and mature ponderosa pine: implications for $O_3$ exposure metrics. Tree Physiology.

Fischer, E. V., Talbot, R.W., Dibb, J.E., Moody, J.L., and Murray, G.L. (2004) Summertime ozone at Mount Washington: Meteorological controls at the highest peak in the northeast. J. Geophysical Research. 109 D24303.

Fisher, J.I., A.D. Richardson, and J.F. Mustard. (2007). Phenology model from surface meteorology does not capture satellite-based greenup estimations. Global Change Biology, 13, p. 707-721.

Matyssek, R., Gunthardt-Goerg, M.S., Maurer, S. and Keller, T. (1995) Nighttime exposure to ozone reduces whole-plant production in Betula pendula. Tree Physiology 15 p. 159-165.

McLaughlin, S.B., Nosal, M., Wullschleger, S.D., Sun, G. (2007a) Interactive effects of ozone and climate on tree growth and water use in a southern Appalachian forest in the USA. New Phytologist. 174: 109-124.

McLaughlin, S.B., Wullschleger, S.D., Sun, G. and Nosal, M. (2007b) Interactive effects of ozone and climate on water use, soil moisture content and streamflow in a southern Appalachian forest in the USA. New Phytologist. 174: 125-136.

Musselman, R. C., and Minnick, T. J. (2000) Nocturnal stomatal conductance and ambient air quality standards for ozone. Atmospheric Environment 34, pp. 719-733.

Smith G. C. and Manning, W. J. (1990) An ozone effects monitoring program for the Class I Wilderness Areas in the White Mountain National Forest of New Hampshire. Interim Report-February 1990.

Synder, K. A., Richards, J.H., Donavan, L.A. (2003). Night-time conductance in $C_3$ and $C_4$ species: do plants lose water at night? Journal of Experimental Botany. Vol. 54 No. 383 pp. 861-865.